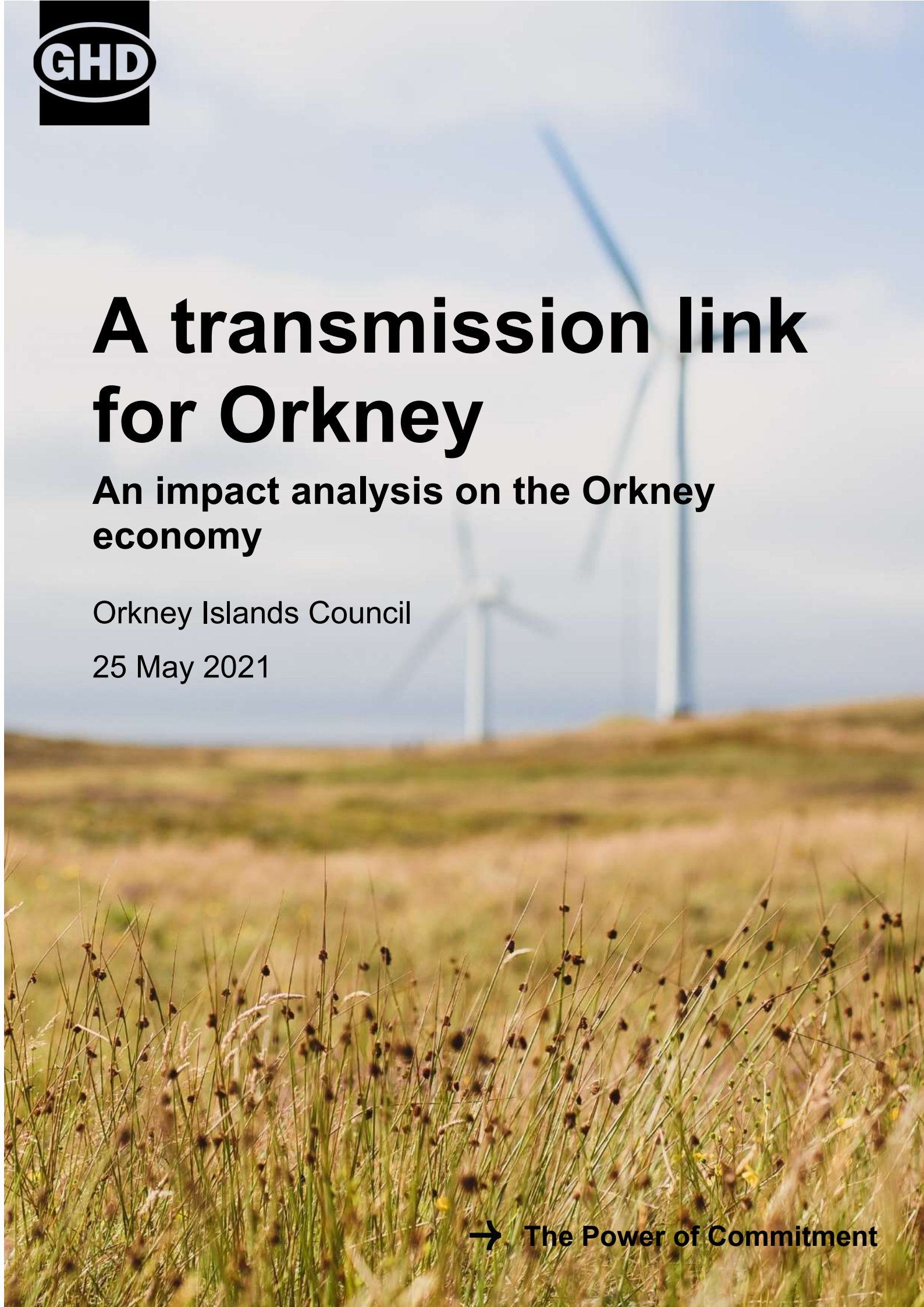

A transmission link for Orkney

An impact analysis on the Orkney economy

Orkney Islands Council

25 May 2021

→ The Power of Commitment

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Executive summary

Orkney is an area rich in renewable energy resources - including long standing onshore wind developments and the more recent exploitation of wave and tidal energy. Wind speeds in Orkney are high, with Orkney wind turbines being some of the most productive in the world. Orkney is also an area of unique tidal flow and wave resource and is home to the European Marine Energy Centre (EMEC) which has hosted testing and demonstration of over 30 marine energy devices. Orkney Islands Council (OIC) has joined the Scottish Government in declaring a climate emergency and is committed to achieving net zero carbon emissions as part of its contribution towards tackling climate change. To help achieve this aim, OIC is seeking to develop three 28.8 MW onshore wind sites under 'Orkney's Community Wind Farm Project'.

However, the existing electricity distribution network in Orkney, connected to the mainland via two subsea cables, is operating at full capacity – with an effective moratorium on new grid connections on the islands in place since 2012. The lack of network capacity has severely limited generation growth and the benefits associated with it. New transmission system infrastructure is needed to ensure Orkney can exploit and benefit from its valuable renewable resource. Fundamental to delivering new transmission infrastructure is the 'Needs Case' made by Scottish and Southern Energy Networks – Transmission (SSEN-T) to the Energy Regulator, Ofgem. Ofgem has subsequently accepted there is a 'need' for reinforcement and stated it is 'minded to' approve the transmission investment, but only if certain conditions are met. The conditions Ofgem has imposed are intended to guarantee a very high degree of 'certainty' around onshore wind generation emerging in the short term. Ofgem requires 135 MW of wind projects to demonstrate their likelihood of development, either by securing revenue support via a Contracts for Difference (CfD) auction, or by securing planning consent and passing a financial audit set by Ofgem. Ofgem's conditions must be met by a recently extended deadline of December 2022.

The contribution of the OIC wind farms to Ofgem's deadline

Our objective analysis of all potential wind farm developments currently identified in Orkney shows that OIC's three wind farms are essential to achieving Ofgem's 135 MW conditionality threshold. The OIC projects show a higher likelihood of development than other potential projects when evaluated using GHD's probability of generation assessment tool (PGAT). The OIC projects score well as they have submitted planning (or will submit planning very soon), have connection offers in place, have identified connection costs, undertaken financial planning and could be eligible to bid into the forthcoming CfD auction. If the Council's projects are not awarded planning in the short-term, then the conditionality threshold is unlikely to be met. The alternative projects that could contribute are at considerably earlier stages of development and so are unlikely to be sufficiently developed to meet Ofgem's conditions by the December 2022 deadline.

As a result, the Scottish Government's planning decisions on OIC's projects are critical to both the development of the projects and therefore the likely development of the transmission link.

The benefit to the Orkney economy

The transmission link, and the renewable generation it enables, will have a significant positive impact on the Orkney economy. We have developed two scenarios to evaluate the Gross Valued Added (GVA) impact for Orkney:

- The 'Conditionality' scenario assumes 135 MW of projects are developed to meet Ofgem's conditions, including the three OIC projects. 'Conditionality' can be considered a 'minimum benefit' scenario.
- The 'Enabled' scenario assumes longer-term renewable growth of around 300 MW is enabled by the transmission link, including tidal flow.

The GVA benefit to Orkney is substantial – ranging from £371 million in the 'minimum' Conditionality scenario, to some £807 million in the Enabled scenario - a GVA benefit corresponding to between £730 and £1,591 a year over the next 45 years to each household in Orkney.

Total Orkney GVA contribution (£million 2021 prices)

	Construction	Operation	Economic Rent	Total
Conditionality	35.0	49.0	286.6	371
Enabled	244.5	240.3	322.2	807

The benefit to the Scottish economy

The GVA benefit of the transmission link and renewable generation will extend far beyond Orkney. While the 'local' Orkney content of the transmission link and renewable generation is large, the overall Scottish content is significantly higher given its wider and deeper business base and supply chains. Consequently, the GVA impact to the wider Scottish economy of the Orkney transmission link and the renewables it supports is considerable, ranging from £606 million in the lowest case Conditionality scenario, to almost £1.5 billion in the Enabled scenario.

GVA impact on Orkney and Scotland (£million 2021 prices)

	Conditionality		Enabled	
	Orkney	Scotland	Orkney	Scotland
OIC	318.3	428.7	318.3	428.7
Other WF	48.8	124.4	101.7	261.1
Marine	0.0	0.0	383.5	740.8
Link	3.5	53.1	3.5	53.1
Total	**371**	**606**	**807**	**1,484**

The renewable energy developed in Orkney will also contribute to achieving the Net Zero aims of the Scottish and UK governments – boosting the potential growth of marine generation and helping diversify the generation mix.

The benefit of the OIC wind farms

The GVA benefit to the Orkney economy of the OIC wind farms is disproportionately large given their unique ownership and revenue recycling model – with a GVA benefit of £3.7 million/MW, around four times greater than that expected for other wind projects. The potential benefit of marine generation enabled by the proposed 220 kV transmission link is also substantial – driven by the marine excellence in Orkney, highlighting the clear enabling potential of the transmission link.

Summary

The OIC projects are critical to meeting Ofgem's conditionality threshold to ensure the Orkney transmission link is finally approved. It should be noted that Ofgem's conditional approval is for SSEN-Transmission's proposed link. If the conditionality threshold of 135 MW is not met, then Ofgem may require a new Needs Case submission that may result in approval for a lower capacity link– significantly reducing the longer-term potential of renewable development in Orkney.

Securing the proposed link will facilitate the creation of significant benefit to the Orkney and Scottish economies and help meet our Net Zero goals. The transmission link the OIC projects support will also enable additional, longer term renewable development and in particular unlock the potential for future development of marine energy technologies.

Contents

Table index

Figure index

Introduction

1.1 Purpose of this report

Orkney is an area rich in renewable energy resources - including long standing onshore wind developments and the more recent exploitation of wave and tidal energy. Wind speeds in Orkney are high, with Orkney wind turbines being some of the most productive in the world. Orkney is also an area of unique tidal flow and wave resource and is home to the European Marine Energy Centre (EMEC) which has hosted testing and demonstration of more than 30 marine renewable energy devices. While Orkney's renewable resource is extensive, realising this potential is currently limited as the existing electricity distribution network in Orkney, connected to the mainland via two subsea cables, is operating at full capacity and so no new projects can connect. Therefore, new transmission system infrastructure is needed to ensure Orkney can further exploit and benefit from its valuable renewable resource.

Under Ofgem's strategic wider works (SWW) a so called 'Needs Case' must be developed by the Transmission Operator (SSEN-Transmission) to provide justification for a new Orkney islands transmission link. The Needs Case takes into consideration key factors such as the expected increase in generation relative to the existing capacity of the network and resulting constraint costs if the reinforcement is not forthcoming, together with a review of uncertainties, such as different generation scenarios.[1] Cost benefit analysis (CBA) undertaken as part of the SWW quantifies the costs and benefits of potential transmission reinforcements – with the benefit of a potential reinforcement assessed as the future constraint costs avoided and costs as the cost of the reinforcement.

However, for the Scottish islands the logic of the CBA approach adopted to date is thwarted by the lack of existing transmission infrastructure that creates an unusual counterfactual resulting in a 'Catch-22' situation as the 'need' for the transmission reinforcement is dependent on the development of generation on the islands, but generation development cannot occur without the transmission reinforcement. Therefore, the case for either transmission or generation development is entirely predicated on the other.

While Orkney has an excellent wind resource, the situation is further complicated by the position of Orkney outside the GB transmission charging zones. Because of Orkney's position outside the main interconnected transmission system (MITS), potential transmission connected generators on the islands will be allocated a 'wider' Transmission Network Use of System (TNUoS) charge to the nearest transmission charging zone, plus a 'local spur' charge for transmission to the islands. Given the relatively high cost of the local spur (a subsea link) then the resulting TNUoS charge for island generators is high. In October 2012, The Rt Hon. Edward Davey and the Scottish Government set up a joint independent study to address concerns that renewable projects on the Scottish islands were '*not coming forward quickly enough, in part because of the cost of the links required to connect the islands to the mainland transmission network*'[2]. Further analysis outlined the increased cost of generation for renewable projects on the islands arising mainly from the increased TNUoS charges. The report also outlined the potential of the islands to generate significant renewable energy, including the further development of marine generation, and the subsequent positive economic impact on island communities.[3]

The higher cost of island generation, coupled with the potential benefit to the islands and their role in the development of embryonic marine generation, led to the then DECC's consultation proposal for an 'islands' CfD. The 2013 consultation on additional support for islands renewables concluded that:

> *'The projects are physically and electrically remote from the high voltage transmission system needed for the export of their generation output and would require long new connections to the Main Interconnected Transmission system based on subsea High Voltage DC cables. Under the transmission charging regimes, they are forecast to be subject to transmission charges (TNUoS) of several times the average for comparable generators located elsewhere in the UK. We consider that the characteristics described above mean that the development of onshore wind on the Scottish islands constitutes a separate class of*

[1] https://www.academia.edu/20243816/The_Importance_of_Revenue_Sharing_for_the_Local_Economic_Impacts_of_a_Renewable_Energy_Project_A_Social_Accounting_Matrix_Approach
https://www.ofgem.gov.uk/sites/default/files/docs/2013/10/guidance_on_the_stategic_wider_works_arrangements_in_riio_t1.pdf
[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/245381/scottish_islands_additional_support_consultation.pdf
[3] https://www.gov.uk/government/publications/scottish-islands-renewable-project-final-report

renewable generation that warrants separate treatment and potentially a different level of support to other onshore projects.'[4]

The 2017 Conservative party's manifesto made a commitment to "support the development of wind projects in the remote islands of Scotland, where they will directly benefit local communities.[5]" The Conservative commitment was reiterated by Richard Harrington, Parliamentary Under Secretary of State at the Department for Business, Energy and Industrial Strategy who stated in a House of Commons debate in July 2017.

'*I hope that my response today….provides some reassurance… that the Government will support the development of onshore wind projects in the remote islands of Scotland, where they will directly benefit local communities*.[6]'

In October 2017 the government finally announced its intention to allow islands wind projects to compete in the 'less established technologies' CfD auction in 2019.[7] Key to the decision was the potential for renewable projects to benefit local communities. It is also understood that 'remote island wind', as well as 'wave and tidal energy' will be supported in the upcoming CfD allocation Round 4 (AR4), scheduled for December 2021.

SSEN-T submitted its Orkney Needs Case for transmission reinforcement to Orkney in 2018. Ofgem subsequently accepted there is a 'need' for reinforcement and stated it is 'minded to' approve the transmission investment, but only if certain conditions are met. The conditions Ofgem has imposed are intended to guarantee a very high degree of 'certainty' around onshore wind generation emerging in the short term. Ofgem requires 135 MW of wind projects to demonstrate that it is 'likely to be developed' by securing revenue support via a CfD auction, or by securing planning consent and passing a financial audit set by Ofgem, by a recently extended deadline of December 2022[8].

There has been a long-term and sustained effort to enable development of renewable energy in the Scottish Islands. Now, with a revenue support mechanism in place to support 'Remote Islands Wind' through the CfD process and the 'Need' for a transmission link acknowledged by Ofgem with its conditional approval, the right conditions finally exist to achieve Orkney's renewable potential.

To date two windfarms have achieved Ofgem's conditions and one further project has passed the first hurdle of securing planning permission:

– In 2019 Hesta Head and Costa Head were awarded a CfD in the Round 3 Auction and were also awarded planning permission
– In 2021 an 8.4 MW extension to the existing Hammars Hill wind farm was awarded planning permission

The three projects amount to 43.2 MW and therefore an additional 91.8 MW of renewable projects are required to achieve planning and demonstrate that they are 'likely to be developed' to meet Ofgem's conditions.

Orkney Islands Council (OIC) is committed to achieving net zero carbon emissions as part of its contribution towards tackling the climate emergency and, as part of its efforts, is seeking to develop three onshore wind sites, each with a capacity of 28.8 MW, under 'Orkney's Community Wind Farm Project'. The projects, if awarded planning, will largely ensure Ofgem's conditionality is met.

The purpose of this report is to objectively assess the potential contribution of planned wind farms to achieving the 135 MW conditionality. In doing so the wind projects, the transmission link they help secure, and additional renewable development enabled, will unlock significant socio-economic benefits for Orkney. This report quantifies these benefits and highlights the criticality of the OIC wind farms in meeting the needs case conditions and triggering the transmission link, and in doing so also enabling the substantial socio-economic benefit that the link will bring.

[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/245381/scottish_islands_additional_support_consultation.pdf
[5] https://www.conservatives.com/manifesto
[6] https://hansard.parliament.uk/Commons/2017-07-04/debates/D202FCC4-4500-4CC9-BED5-0439C39D2ED1/RenewableEnergyGenerationIslandCommunities
[7] https://www.gov.uk/government/news/boost-for-island-wind-projects-as-uk-government-announces-new-funding-for-renewable-generation
[8] https://www.ofgem.gov.uk/system/files/docs/2021/05/ofgem_response_to_orkney_deadline_extension_request.pdf

Generation assessment

2.1 Background

The Scottish Government adopted the National Islands Plan in December 2019 as required by The Islands (Scotland) Act 2018. The Islands (Scotland) Act sets out the purpose of the National Islands Plan and the main objectives and strategy of the Scottish Government in relation to improving outcomes for island communities. The National Islands Plan recognises the benefits renewable development can bring to island communities – including socio economic benefits and those related to wider climate change and Scotland wide electricity demand. The National Islands Plan also recognises the importance of transmission links and the benefits realised from the reinvestment of revenues associated with islands renewable development. OIC's proposed wind farms and their contribution to the business case for delivering an Orkney transmission link, will help deliver the objectives set out in the National Islands Plan.

The Scottish Government's National Planning Framework 3 (NPF3) also identifies the proposed transmission link between Orkney and the Scottish mainland as a 'National Development,' with the link essential to realising the potential for renewable energy development in Orkney.

The Orkney Sustainable Energy Strategy 2017-2025[9] reiterates one of the Orkney communities overarching aims underpinning the energy strategy to:

> '*add value to Orkney's renewable energy resources, for the benefit of the local economy and local communities*….

The energy strategy outlines the importance of renewables to the islands, with local production of renewable electricity over 120% of Orkney's electricity needs. However, it also claims that:

> *'a significant external factor has been the delay in major grid reinforcement to Orkney and, although some strengthening of the local grid has been delivered, the 2014 Orkney-wide Energy Audit identified 40-50% curtailment of renewable generation.'*

The curtailment of renewable generation in Orkney and the considerable opportunity cost of this curtailed generation motivated the Council to declare grid reinforcement fundamental to its energy strategy, stating that:

> '*the ability to export energy to the Scottish mainland is constrained by inadequate electrical grid infrastructure. This theme can be considered as crosscutting in support of the strategy to drive Island related issues forward…. In recent years the negative impact of constraint and curtailment has cost the community dearly and these barriers to delivering a low carbon economy still need to be influenced and addressed*.'

As part of its long-term strategy, OIC is seeking to develop three onshore wind farms. Sites have been identified and planning submitted/close to submission. In addition to the OIC projects, there are a further six wind farm projects of relevant scale[10] at various stages of development that are considered in this report in terms of their ability meet Ofgem's conditionality threshold of 135 MW.

2.2 Probability of generation assessment

In order to evaluate the importance of the OIC windfarms in achieving Ofgem's conditionality, we have 'scored' all nine potential larger scale wind farms using our 'probability of generation assessment tool' (PGAT). GHD's PGAT model scores potential wind farm projects against a range of criteria identified as primary indicators of short/medium term project development potential – the criteria and their weighting used to evaluate final project scores are shown in Table 1.

[9] https://www.orkney.gov.uk/Files/Consultations/Sustain-Orkney-Energy-Strat-1725/Sustainable_Orkney_Energy_Strategy_Accessible.pdf
[10] Above 5 MW total size

Table 1 PGAT scoring criteria

Project drivers	Categories	Weighting (%)
1	Network Contractual Status	10
2	Project Planning Status	35
3	Ownership / Financial Considerations	15
4	Offtake contract	10
5	Economies of scale	5
6	Distance to Connection	25
	Total	100
Additional project drivers for projects in the pre-planning/planning phase		
These drivers are additional scoring factors to further differentiate projects in pre-planning/planning	Location favourability	Projects scored against wind spatial plan
	Tip height	Tip height in excess of 150m considered unfavourable for planning
	Community funding	Projects with more generous community funding plans score higher

PGAT has been used by GHD for a number of cost benefit analyses, including the Western Isles Needs Case and the Skye reinforcement CBA for SSEN-Transmission. As part of the process, PGAT was evaluated and the methodology accepted by both Ofgem and the Electricity System Operator. The aim of PGAT is to identify those projects with the greater prospect of proceeding in the short to medium term.

The PGAT results for each of the projects (above 5 MW) identified in Orkney are shown in Table 2.

Table 2 PGAT scores for Orkney wind generation – over 5 MW

Wind Farm	PGAT score	PGAT rank	MW
Hammars Hill extension	75	1	8.4
OIC Quanterness	69	2	28.8
Hesta Head	68	3	20.4
Costa Head	66	4	16.3
OIC Hoy	54	5=	28.8
OIC Faray	54	5=	28.8
Subtotal			**132**
Stronsay	48	7	30
Eday	35	8	30
Rennibister	30	9	20

Hammars Hill extension scores highly – the project has planning permission, high community ownership and benefits from extension cost efficiencies. Hesta Head and Costa Head benefit from planning permission and CfD award, with Hesta scoring slightly higher as a larger project with associated efficiencies.

Our objective scoring indicates that the OIC projects have a greater probability of proceeding in the medium term than the three other larger projects identified in Orkney – with all three OIC projects scoring above Stronsay, Rennibister, and Eday. The OIC projects achieve better scores as they have submitted planning (or will submit planning very soon), have connection offers in place, have identified connection costs, undertaken financial planning and could be eligible to bid into the forthcoming CfD auction. Quanterness scores particularly well as it benefits from very low connection costs.

As Table 2 shows, if the six highest scoring projects proceed, then Ofgem's conditionality is broadly achieved with 132 MW. Our analysis has also identified up to 10 MW of small scale, sub 5 MW projects that have planning, some of which may proceed to development, adding to the 132 MW.

Achieving planning permission for the OIC projects is central to meeting Ofgem's 135 MW conditionality threshold. If the OIC projects are not awarded planning, then the conditionality threshold is very unlikely to be met. Stronsay, Rennibister, and Eday are at the site identification or screening/scope stage of development – with their probability of proceeding in the short/medium term considerably lower than the OIC projects.

Therefore, we can conclude that, based on the outcome of our objective analysis, the OIC projects are crucial to the timely achievement of Ofgem's 135 MW conditionality threshold.

Socio economic impact assessment

The transmission link and the renewable development it enables will have a positive socio-economic impact on the economy of the Orkney islands. The aim of our analysis is to quantify the benefit to the local economy of the transmission link and renewable generation enabled. We have identified two broad scenarios:

1. Conditionality – here we evaluate the benefits of the 135 MW of wind generation required to meet Ofgem's short term conditionality threshold. This can be viewed as the 'minimum' scenario.
2. Enabled – this scenario evaluates the potential for longer term benefits to arise from further wind farm and tidal development in the longer term enabled by the 220 kV transmission link. GHD's analysis of the 220 kV transmission link for SSEN-Transmission suggests that 300 MW of wind and tidal generation can be relatively easily accommodated with few energy constraints.

Table 3 shows the generation breakdown assumed in the two scenarios. We assume marine development is predominantly tidal flow, developing with increasing significance in the later 2020s and early 2030s as the technology advances and commercialises.

Table 3 Orkney generation scenarios

Scenario	OIC wind farms	Other onshore wind	Small Scale wind	Tidal flow	Total
Conditionality	86.4	45.1	4	0	135.5
Enabled	86.4	100.1	5.8	108	300.3

3.1 The Orkney economy

The Orkney economy has been traditionally reliant on agriculture and fishing. However, over the last 20 years there has been a growth in employment in a number of economic sectors including manufacturing, tourism, food processing and, more recently, renewable energy.

Table 4 Contribution to 2017 Gross Value Added by Industry (£million) [11]

	Orkney		Shetland		Scotland	
Agriculture, mining, electricity, gas, water and waste	89	16%	135	16%	11,722	8%
Manufacturing	33	6%	72	9%	14,669	11%
Construction	58	10%	104	13%	8,671	6%
Distribution; transport; accommodation and food	118	21%	169	21%	23,995	17%
Information and communication	9	2%	12	1%	5,086	4%
Financial and insurance activities	9	2%	11	1%	8,264	6%
Real estate activities	80	14%	74	9%	17,822	13%
Business service activities	36	6%	50	6%	14,132	10%
Public admin; education; health	126	22%	150	18%	29,763	21%
Other services and household activities	15	3%	42	5%	5,212	4%
All industries	573	100%	819	100%	139,336	100%

[11] GVA reference tables – table 6 – GVA (Income Approach) by SICo7 industry at current basic prices

Table 4 shows the contribution to Orkney GVA of individual sectors of the economy and compares to that of Shetland and Scotland as a whole. The relatively large contribution of agriculture/fishing/mining and utilities is apparent, contributing 16% to Orkney GVA, compared to 8% in Scotland overall. Orkney also has a relatively large construction and tourism related sectors – in common with Shetland. The contribution of finance and business services is also relatively low in Orkney and Shetland compared to Scotland as a whole.

3.1.1 Population

While the population of Orkney is growing, it is also aging. In 2019, the population of Orkney was 22,300. Around 80 per cent of the population live on the Orkney mainland, particularly in the two biggest towns of Kirkwall and Stromness. More than a fifth of Orkney's population are aged 65 or over (21%), a higher proportion than across Scotland (18%). Over the past decade, the number of older people increased by almost a third (31%), three times the average rate in Scotland. The proportion of young people in Orkney (17%) is similar to the Scottish average but has decreased by seven per cent over the past decade. It is projected to decrease by a further three per cent by 2037[12].

Despite an aging population, Orkney has a relatively high proportion of those considered economically active[13] at 86%, compared to 77% in Scotland. Of those economically active, a high proportion are in employment, 82% compared to 74% in Scotland. Employment in Orkney is skewed towards skilled trades accounting for over 20% of employment compared to 9% in Scotland. Conversely those in professional occupations are fewer, accounting for 36% of employment compared to 50% in Scotland[14].

3.1.2 Future growth

Orkney Islands Council considers energy has the potential to make a significant contribution to Orkney's future economic prosperity and points to the significant progress made in Orkney, including a high per capita number of electric vehicles and high contribution of renewables.[15] Orkney is home to a high concentration of small and micro wind turbines as well as several larger community owned and commercial turbines with varying degrees of local ownership[16].

OIC's support for renewable energy is high and renewable energy is considered a potential solution to a long-term and growing gap in Council finances. The Council has invested in renewable projects in Orkney, including Hammars Hill wind farm - the weighted average return from the Council's investment in Hammars Hill Energy Limited is 11.9%. The three proposed OIC wind farms cement OIC's commitment to renewable energy and realising the benefits it can bring to the Orkney economy.

3.2 Methodology

Impact analyses of local investments typically employ some form of Keynesian multiplier framework to assess the effects of the investment stimulant. These are models that identify the knock on, or 'multiplier,' effects of increased local expenditure. The most sophisticated employ input output (IO) tables that capture linkages between the production sectors of an economy – in simple terms IO tables outline from which sectors another receives its production inputs and to which sectors it sends outputs. The IO technique used for calculating the direct, indirect and induced impacts of an increase in local economic activity from the transmission link and renewable development generates the Gross Value Added (GVA) to the Orkney economy.

Expenditure arising from transmission and renewable energy development will impact the Orkney economy at three broad levels:

– Direct impact: increased post-tax profit, wages and employment produced directly by project expenditure. To compute the direct GVA impact, sector-matched expenditure is multiplied by the relevant GVA-output ratios.
– Indirect impact: increased post-tax profit, wages and employment created from employment of sub-contractors and demand for goods and services from suppliers down the supply-chain.

[12] http://www.audit-scotland.gov.uk/docs/central/2014/nr_141106_orkney_cpp.pdf
[13] People who are either in employment or unemployed
[14] https://www.nomisweb.co.uk/reports/lmp/la/1946157427/report.aspx?town=orkney#tabrespop
[15] https://www.orkney.gov.uk/Files/Consultations/Sustain-Orkney-Energy-Strat-1725/Sustainable_Orkney_Energy_Strategy_Accessible.pdf
[16] http://www.oref.co.uk/orkneys-energy/wind/

– Induced impact: increased post-tax profit, wages and employment generated from greater demand and spending on goods and services such as accommodation, food, fuel and retail by employees who are employed as a result of the direct and indirect impacts.

Indirect and induced impacts are assessed using 'Type I' and 'Type II' multipliers. While these are available for Scotland, there is very limited data for Orkney. Therefore, we have used multipliers calculated for Shetland that has a relatively similar GVA industry contribution to Orkney (as shown in Table 4). Using an IO model, the GVA and years of employment supported can be calculated that result from transmission and renewable energy expenditure.

However, IO models that can be developed using these databases have drawbacks when used for identifying the economic impact of projects in localised regions, key drawbacks include:

– Lack of regional IO data upon which to assess an appropriate multiplier effect for Orkney.
– Renewable and transmission projects do not typically have strong backward linkages into a local economy such as Orkney – much of the required investment is imported. Such low apparent backward linkages for an onshore wind farm will result in a low IO output multiplier, signifying low indirect and induced impacts on economic activity from the wind farm.
– IO models do not capture the impact of 'economic rent' from renewable generation that might accrue to the local economy, particularly important for projects in partial or total community ownership.

We have adopted an approach that attempts to address the drawbacks of the IO approach and is similar to those used in a number of studies[17] [18] [19] [20] [21] . Our approach determines the Gross Value Added (GVA) to the Orkney economy of investment in wind farms based on the following methodology:

– Project expenditure is categorised into three key groupings – development costs, capital costs and operating costs. Total expenditure and category breakdown is based on various sources, including BEIS[22], World Energy Council[23], International Renewable Energy Agency[24] and various industry reports[25].
– These costs are then further deconstructed into relevant ONS Standard Industry Classifications (SIC)[26].
– A local content for each SIC is determined based on similar studies for Scottish regions, Orkney and Shetland[27] [28] [29] [30].

[17] The importance of revenue sharing for the local economic impacts of a renewable energy project: A social accounting matrix approach, Allan et al, Regional Studies, Vol 45.9, Oct 2011
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[20] Economic benefits from onshore windfarms, BVG Associates, September 2017
[21] Economic benefits from the development of wind farms in the Western Isles A report for EDF Energy Renewables on behalf of Lewis Wind Power, Feb 2017
[22] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/911817/electricity-generation-cost-report-2020.pdf
[23] World Energy Resources, Wind 2016, WEC
[24] Wind Power Technology Brief, IRENA, March 2016 Solar and wind cost reduction potential to 2025, IRENA, June 2016
[25] Market Stabilisation analysis: Enabling Investment in established low carbon electricity generation, An Arup report for Scottish Renewables, July 2017
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[26] https://www.ons.gov.uk/methodology/classificationsandstandards/ukstandardindustrialclassificationofeconomicactivities
[27] Socio economic impacts of community wind power projects in Northern Scotland, Okkonen et al, Renewable Energy 85 (2016
[28] Economic benefits from the development of wind farms in the Western Isles A report for EDF Energy Renewables on behalf of Lewis Wind Power, Feb 2017
[29] Economic benefits from onshore windfarms, BVG Associates, September 2017
[30] Clyde Wind Farm Extension – Impact Analysis June 2015

– Gross Value Added by SIC for Orkney published by the ONS[31] show that the structure of the Orkney economy, in terms of the contribution of each key SIC to GVA, is broadly similar to Shetland. As no IO tables for Orkney have been calculated we use Shetland Input Output and employment multipliers to determine GVA impact and employment effects[32].
– In addition, we have assessed the potential GVA and employment effects that will arise from retained 'economic rent' from community ownership/benefit payments – these benefits are not part of the IO assessment but are important contributors to the Orkney economy – particularly so for the OIC wind farms.
– Not all renewable energy 'economic rent' stays within Orkney – some is assumed to 'leak' from the economy[33]. The retained 'rent' will have an additional economic impact which we have determined by assessing Orkney sector GVA contribution and assuming retained rent mirrors this. The relevant sector IO multipliers are used to assess GVA. However, for the OIC wind farms we assume retained economic rent will be distributed to sectors broadly identified in the OIC's 2020/21 expenditure plans.
– Total benefits are assessed over 45 years (the economic life used by Ofgem to evaluate new transmission network assets) and all results are expressed in 2021 prices.

Our approach allows both the individual nature of the Orkney economy to be taken into consideration, along with the impact of retained economic rent from renewable energy development depending on the ownership structure adopted.

3.2.1 Community benefits

An important benefit to the Orkney economy will result from income arising not fully considered in the IO analysis. This income arises from two sources:

– Community payments made by the owner/operator of any commercial wind farms; these payments are paid by non-community owned wind farms at a rate of £5,000/MW/year
– Community income received from retained 'economic rent' arising from ownership of part, or all, of a renewable development – this is particularly pertinent for the OIC projects.

For the community owned proportion of any project, income received is based on the concept of 'economic rent'. Economic rent is determined by a two-stage approach.

– First the lifetime levelised cost (LLC) of a project is calculated
– Second, for a commercial wind farm project, we assume the sale price of electricity is the current CfD strike price for remote island wind –amounting to £45.4/MWh in 2021 prices[34]. 'Rent' is then determined as the difference between the initial LLC and the required strike price. After the 15-year CfD period we assume the sale price of electricity increases marginally to £48/MWh (2021 prices).

After 20 years we assume a wind project will be repowered. We assume project capex will fall by 20% to reflect continuing technology improvements, more competitive supply chains and economies of scale, including more efficient turbines able to improve project wind yields.[35].

For smaller scale (sub 5 MW) projects the sale price is assumed to be as for commercial wind farms, with an uplift of 20% to reflect the displacement of metered electricity consumption with the output from the small-scale project. The LLC of small-scale projects is greater due to higher capex and lower assumed achieved capacity factors of 38% compared to 45% for commercial projects. But smaller scale projects are also assumed to incur lower Use of System charges.

For tidal flow projects, given that future profit is highly dependent on potential subsidy and subsequent strike prices, we conservatively assume an absolute 'profit' margin akin to a non OIC wind farm.

We assume a variety of community and commercial ownership across the wind projects identified. Council owned wind farms are assumed to be 100% Council owned and 90% of all economic rent retained on the islands –

[31] Regional gross value added (income approach) reference tables published on 15 December 2020 https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/regionalgrossvalueaddedincomeapproach
[32] An Analysis of the Shetland Economy, G. Dyer et al. A report for Shetland Islands Council 2013
[33] In the form of central taxation and spending outside Orkney
[34] RIW strike prices from CfD R3 of £39.7/MWh inflated from 2012 prices to 2021 prices at CPI
[35] https://irena.org/-/media/Files/IRENA/Agency/%20Publication/2019/Oct/IRENA_Future_of_wind_2019.pdf

capturing additional benefits such as landowner rent. Other commercial wind farms will have a lower proportion of local ownership, we assume an average local ownership of 50%, with rent leakage of 50%. For small scale wind, we assume local ownership of 90% and 30% leakage. For tidal projects– we assume 20% local ownership, with 60% leakage.

For non OIC projects we assume the economic rent identified is distributed in the local economy in line with GVA contribution as outlined in Table 4. The GVA impact of the distributed economic rent is calculated using the IO methodology. For the OIC projects we assume 'rent' is allocated to those sectors that mirror OIC's 2020/21 budget allocation spending – with Health and Care accounting for 24% of budget; policy and resources 11%; development and infrastructure 19% and education, leisure and housing 46%.[36]

3.3 Orkney local content

We have assessed the Orkney content of wind projects based on a number of reports, including Renewable UK's Economic Impacts of onshore wind[37] [38] [39].

3.3.1 Onshore wind farms

For the onshore wind farms in Orkney, we have assessed a 'local' Orkney content of the following areas:

– Development and project management
– Wind turbines
– Balance of plant (supply and installation)
– Operation and maintenance

Development and project management

Development and project management is assumed to include a local Orkney content of some 13% for non OIC commercial wind projects. While development activity will take place outside Orkney, the three OIC wind farms will involve a relatively high proportion of local development content of 25%.

Wind turbines

None of the main wind turbine components will be sourced from Orkney – although we assume a greater local activity in turbine transport to Orkney. We calculated 1% Orkney content of the turbines and 20% of transport costs will be Orkney sourced. We assume a slightly higher transport content for OIC projects at 25%. For small scale wind turbines, we assume a higher contribution of Orkney transport of 40%.

Balance of Plant

Balance of plant covers the civil and wind farm electrical works. For the civil works, we have assumed a high Orkney content of 50% - reflecting the relatively high contribution of construction to the Orkney economy. For small scale wind turbines local content is higher at 60%. For electrical works – almost all components are likely to be imported, although an electrical engineering supply chain is available in Orkney, therefore local content is assumed to be 30%.

Operation, maintenance and decommissioning

Orkney has a disproportionately large number of small-scale wind turbines and the renewable industry is increasing in importance to the Orkney economy. Maintenance of the wind farms will employ local wind farm technicians – although major repairs are likely to require specialist, imported services.

Based on the assumptions above, Table 5 shows that the overall Orkney content in larger, commercial wind farms is some 21%, rising to 38% for small scale wind turbines. The OIC projects have a relatively high local content of 26%.

[36] Orkney Islands Council Key Facts and Figures 2020-2021
[37] http://c.ymcdn.com/sites/www.renewableuk.com/resource/resmgr/Publications/Reports/onshore_economic_benefits_re.pdf
[38] Clyde windfarm extension – Impact Analysis, PWC June 2015
[39] Economic benefits from the development of wind farms in the Western Isles, BVG Associates 2017

Table 5 Orkney content of wind projects

Category	% of TOTEX	Geography	% content of category		
			OIC wind	**Commercial wind**	**Small scale wind**
DEVEX	4%	Orkney	25%	13%	50%
		Non-Orkney	75%	87%	50%
CAPEX	59%	Orkney	13%	11%	15%
		Non-Orkney	87%	89%	85%
OPEX	38%	Orkney	47%	36%	73%
		Non-Orkney	53%	64%	27%
TOTEX	100%	Orkney	26%	21%	38%

The local content determined in our analysis broadly similar to that adopted in other studies in Scotland – together with Renewable UK's analysis for 'local' content for UK onshore wind – as outlined in Table 6.

Table 6 Local Content comparable studies

Local content	Renewable UK[40] (2017)	BVG – Western Isles (2017)	Biggar Economics – Scottish Borders[41] (2013)	BVG Scotland[42] (2017)	Okkonen et al Shetland/ Orkney (2015)	Baringa Orkney (2016)
Construction	12%	5-11%	5-10%	2%	14%	12%
Operation	42%	22-37%	29-40%	25%	63%	42%
Total	27%	13-24%	25%	16%	37%	25%

We assume the technical life of a wind turbine/farm to be 20 years, after which the turbine/farm will be repowered – with subsequent additional CAPEX. Conservatively we do not assume an increase in MW capacity when the wind turbine/farm is repowered, although we also assume a 20% reduction in CAPEX.

3.3.2 Marine

A survey of marine energy companies working in the UK by RenewableUK found the industry has already invested over £578 million developing various technologies with over 77% of this spent in the UK economy. [43] Research conducted by Scottish Renewables in 2014 showed that at that time, the companies surveyed had invested more than £200 million into the Scottish economy, and that more than 62% of the companies' supply chain is Scottish[44]. Orkney Islands Council has invested in major new harbour developments at Hatston near Kirkwall, at Lyness on the island of Hoy and at Copland's Dock in Stromness. In addition, Highlands and Islands Enterprise has created onshore facilities for developers at Hatston, with further projects and harbour developments planned.

In our analysis we have assumed only tidal projects progress, as this technology is currently more advanced than wave. However, we expect that the benefits of wave energy development to be broadly similar to tidal and so our

[40] http://c.ymcdn.com/sites/www.renewableuk.com/resource/resmgr/Publications/Reports/onshore_economic_benefits_re.pdf
[41] Economic Impact of Wind Energy in the Scottish Borders, Biggar Economics, Mar 2013
[42] Economic benefits from onshore wind farms - A report for ScottishPower Renewables, BVG, September 2017
[43] http://www.marineenergywales.co.uk/wp-content/uploads/2016/01/Capitalising-on-Capability-2015.pdf
[44] Scottish Renewables, Marine Milestones 2013-14

results could largely apply to either technology. For tidal generation in Orkney, we have assessed a 'local' Orkney content for the following areas:

– Development and project management
– Device development and manufacture
– Balance of plant (foundations, mooring installation, electrical systems)
– Operation, maintenance and decommissioning

Development and project management

Given the important role of Orkney in the development of tidal generation in the UK to date organisations with a track record in the marine environment are likely to well placed to undertake project development work, particularly where local knowledge is an asset – such as site-specific conditions in and around the Pentland Firth and Orkney waters. Therefore, we assume a relatively high development and project management local Orkney content of 40%.

Device development and manufacture

Generation devices are likely to account for 20% to 40% of total project costs.[45] While large scale device manufacture is unlikely to be located in Orkney, considerable supply chain activities and some smaller component manufacture is likely to be in Orkney. We calculated 10% Orkney content in device and 25% of transport costs will be Orkney sourced.

Balance of Plant

Balance of plant covers foundations, mooring installation and electrical systems. For the civil works (foundations and moorings), we have assumed a high Orkney content of 75%. For electrical works local content is limited to 30%.

Operation, maintenance and decommissioning

Operating and maintaining tidal projects is likely to involve considerable Orkney input. Some technology developers envisage that devices will be maintained partially in-situ while others will require disconnection and towing to shore for maintenance. The developments at port facilities will encourage supply chain development and clustering. The vessels used for O&M are also likely to be locally based. Overall, we assume a total local content of 53% for O&M of tidal projects.

Table 7 summarises local Orkney content for each key development stage of tidal generation, overall local content in total project spend is some 40%.

Table 7 Local content tidal generation

	% of TOTEX	Orkney content
DEVEX	1.5%	40%
CAPEX	61%	35%
OPEX	37.5%	53%
TOTEX	100%	40%

3.3.3 Transmission reinforcement

The breakdown of transmission investment costs is based on information providing by SSEN-T and GHD's own analysis. Broad expenditure categories include:

[45] Wave and dal energy in the Pentland Firth and Orkney waters: How the projects could be built, Crown Estate 2011

– Development costs
– Cable
– Static Var Compensation
– Substations

Local content assumptions for significant components such as substations, cable, SVRs and electrical works are very limited – at around 0.5-1.0%. However larger local content is assumed for construction elements. Overall, we have assumed a local content for transmission investment of some 3%.

3.3.4 Scottish content

The benefit of the transmission link and renewable generation will extend beyond Orkney to the wider Scottish economy. Table 8 shows the TOTEX content assumed (based on the analysis above) for Orkney economy and that assumed for the wider Scottish economy.

Table 8 Local and Scottish TOTEX content

	Orkney content	Scottish content
OIC	26%	75%
Other wind	22%	75%
Marine	40%	75%
Transmission link	3%	45%

Results

4.1 Gross Value Added

Gross value added (GVA) measures the contribution made to an economy by an individual producer, industry, sector or region and is one way of measuring economic output. The GVA impacts determined by our analysis includes the contribution of all wind developments (large and small), marine and the transmission link. Table 9 shows the resulting total GVA impacts for the two generation scenarios considered.

Our results show that the transmission link, and the renewable generation it enables, will have a significant positive impact on the Orkney economy. The GVA benefit is substantial – ranging from £371 million in the 'minimum' Conditionality scenario, to some £806 million in the Enabled scenario.

Table 9 Total Orkney GVA for each scenario (£million 2021 prices)

	Construction	Operation	Economic Rent	Total
Conditionality	35.0	49.0	286.6	371
Enabled	244.5	240.3	322.2	807

4.1.1 The wider GVA contribution

The GVA benefit of the transmission link and renewable generation it enables will extend far beyond Orkney. While the 'local' Orkney content of the transmission link and renewable generation is substantial, the overall Scottish content is considerably higher given its wider and deeper business base and supply chains. The GVA impact of the Orkney transmission link to the wider Scottish economy is therefore substantial, ranging from £606 million in the lowest case Conditionality scenario, rising to almost £1.5 billion in the Enabled scenario.

Table 10 GVA impact on Orkney and Scotland (£million 2021 prices)

	Conditionality		Enabled	
	Orkney	Scotland	Orkney	Scotland
OIC	318.3	428.7	318.3	428.7
Other WF	48.8	124.4	101.7	261.1
Marine	0.0	0.0	383.5	740.8
Link	3.5	53.1	3.5	53.1
Total	**371**	**606**	**807**	**1,484**

4.2 The contribution of the OIC windfarms

Given the OIC project's unique ownership and revenue recycling status, their three wind farms provide a disproportionately positive impact on the Orkney economy. Table 11 shows the breakdown of GVA benefit by generation type in the Conditionality scenario, with the OIC projects identified separately. The results show the important GVA impact of the OIC projects – driven in particular by their unique revenue recycling.

Table 11 Total Orkney GVA contribution – Conditionality scenario (£million 2021 prices)

Benefit	Capex	Opex	Economic Rent	Total
OIC	21.8	32.4	264.1	318.3
Other wind	11.2	15.1	22.5	48.8
Tidal	0.0	0.0	0.0	0.0
Transmission	2.0	1.5	0	3.5
Total	**35.0**	**49.0**	**286.6**	**370.6**

Table 12 shows the GVA impact of additional wind and tidal generation enabled in the longer term by the link. The potential contribution of marine generation is clearly evident – with considerable benefit to the Orkney economy of both development and operation of marine power.

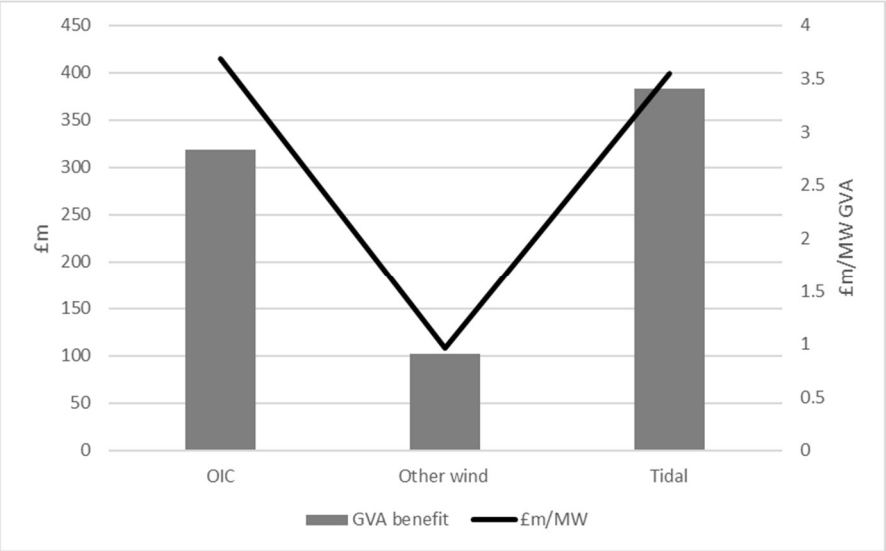
Table 12 Total Orkney GVA contribution – Enabled scenario (£million 2021 prices)

Benefit	Capex	Opex	Economic Rent	Total
OIC	21.8	32.4	264.1	318.3
Other wind	23.8	31.4	46.5	101.7
Tidal	196.9	175.0	11.6	383.5
Transmission	2.0	1.5	0	3.5
Total	**244.5**	**240.3**	**322.2**	**807.1**

Figure 1 shows the relative GVA benefit of the OIC windfarms compared to other wind and tidal in the 'Enabled' scenario. The £million/MW GVA benefit of the OIC wind farms is substantial at almost £3.7 million/MW and is considerably higher than alternative wind farms – driven by the OIC projects' unique ownership and recycling of project economic rent.

The potential benefit of marine generation enabled by the proposed 220 kV transmission link is also substantial – driven by the marine excellence in Orkney, highlighting the clear enabling potential of the transmission link.

Figure 1 GVA contribution by project type – Enabled scenario



It should be noted that Ofgem's conditional approval is for SSEN-Transmission's proposed 220 kV link. If the conditionality threshold of 135 MW is not met, then Ofgem may require a new Needs Case submission that may result in approval for a lower capacity link of 132 kV – significantly reducing the longer-term potential of renewable development in Orkney.

4.3 Economic benefit analysis

Table 13 shows a more detailed breakdown of total GVA benefit to Orkney and its residents of the two scenarios. The lowest case Conditionality scenario results in an average annual benefit to each Orkney household of £730, increasing to £1,591 in the Enabled scenario.

Table 13 Orkney GVA benefit analysis

Scenario	*Lifetime Economic Benefit (£million)*	*Economic benefit per annum (p.a.) (£million)*	*Economic benefit per capita p.a. (£)*	*Economic benefit per household p.a. (£)*	*Economic benefit p.a. as a proportion of Total GVA (%)*	*Economic benefit per household p.a. as a Proportion of Average GDHI (%)*
Conditionality	£371	£8.2	£371	£730	1.4%	3.9%
Enabled	£807	£17.9	£807	£1,591	3.1%	8.5%
			…based on population of Orkney in 2018	**…based on number of Orkney households 2018**	**…based on Orkney GVA (£million)**	**…based on Orkney average GDHI 2018 (£)**
			22,190	11,261	£573	£18,783

4.4 Summary

Our analysis shows that the OIC wind farms are critical to meeting Ofgem's 135 MW conditionality threshold. The OIC projects score well in our probability of generation assessment as they have submitted planning (or will submit planning very soon), have connection offers in place, have identified connection costs, undertaken financial planning and could be eligible to bid into the forthcoming CfD auction. If the Council's projects are not awarded planning in the short-term, then the conditionality threshold is unlikely to be met. The alternative projects that could contribute are at considerably earlier stages of development and so are unlikely to be sufficiently developed to meet Ofgem's conditions by the December 2022 deadline.

Triggering the transmission connection will create a £371 million GVA benefit to Orkney from those projects that are required to meet the needs case conditions, extending to £807 million GVA benefit from further enabled wind and tidal projects.

The GVA benefit to the Orkney economy of the OIC wind farms is disproportionately large given their unique ownership and revenue recycling model, assessed at around four times greater than other wind farms.

The GVA benefit of the transmission link and renewable generation will extend far beyond Orkney. While the 'local' Orkney content of the transmission link and renewable generation is considerable, the overall Scottish content is significantly higher given its wider and deeper business base and supply chains. The GVA impact to the wider Scottish economy of the Orkney transmission link and the renewables it supports is substantial, ranging from £606 million in the lowest case Conditionality scenario, to almost £1.5 billion in the Enabled scenario.

In summary, the OIC projects are critical to meeting Ofgem's conditionality threshold and releasing potentially significant benefits to the Orkney and Scottish economy – enabling additional, longer term renewable development, and in particular unlocking the potential for future development of marine energy technologies.

A-1 Appendix A

Scope and limitations

This report is subject to, and must be read in conjunction with the assumptions and qualifications contained throughout the Report

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